REMARKS/ARGUMENTS

Description of amendments

Claims 1-30 are now pending and under examination. Applicants have amended claims 1, 3-8, 14, 17-24, 26, and 28-30. No new matter has been added.

The amendment to claim 1 is supported by the application as originally filed (see, for example, Table 1 and Example 6 of the specification). As described in the specification, the aging treatment for the titanium alloy is conducted at 350°C to 500°C. Cooling is usually air cooling, and the cooling rate, as shown in Table 1, is retarded by furnace cooling for the titanium alloys that are required to improve the hardness by making the precipitated tissue finer. In other words, a hard ω-phase can be precipitated finely in the β-phase or α+β-phase. Therefore, the precipitation of the ω-phase, which is excellent in corrosion resistance, can be reduced while the α-phase, which is poor in corrosion resistance, is precipitated much more. Further, for those titanium alloys required to precipitate the α-phase more uniformly and finely, a two step aging treatment is adapted.

Moreover, as described in the specification (page 23, line 16 to page 24, line 2), the corrosion resistance test is conducted for each of the manufactured test pieces. The test results show that the rolling device of the present invention is suitable to use under very acidic solutions, such as a sulfuric acid, or very alkaline solutions. Since the hardness of Hv 400 or more and Hv 600 or less is a

hardness comparable to that of the stainless steels such as SUS630 or YHD50 currently used as bearing materials for special circumstances, the present invention can be used under a large load, and a non-magnetic property is also obtained.

Allowed and allowable claims

Applicants appreciate that the Examiner has indicated claims 6-10, 20, 21, 23-28, and 30 would be allowable if they are rewritten to overcome the rejection under 35 U.S.C. §112, second paragraph, and/or to include all of the limitations of the base claim and any intervening claims.

Rejection under 35 U.S.C. §112, second paragraph

Claims 1-30 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention.

Regarding claims 1 and 6, Applicants have amended the claims to overcome the rejection. However, the word "type" is still used claims. The word "type" as used in claims 1 and 6 is a term of art and is not indefinite to a person with ordinary skill in the art. A search in the Internet will show that this use of the word "type" is widespread.

Regarding the language "one kind of materials" in claims 5, 6, 14, 29 and 30, Applicants have amended the claims to modify this language.

Regarding claim 8, Applicants believe that the amendments to claim 8 and the above comments regarding the word "type" are sufficient to overcome the rejection.

Regarding claims 23 and 24, Applicants believe that the amendments to claims 23 and 24 are sufficient to overcome the rejection.

Regarding claim 26, the amendments to claim 26 render the rejection moot.

Regarding claim 29, the rejection is traversed because, contrary to the Examiner's statement, claim 19 does not claim a superhard alloy or cement.

Regarding the term "rolling element" in claims 5, 17-24, 26, and 29, the amendments to the claims overcome the rejection.

Regarding claim 28, the amendment to the claim overcomes the rejection.

Objection to claim 29

The objection to claim 29 is traversed because, contrary to the Examiner's statement, claim 19 does not claim a superhard alloy or cement.

Rejections under 35 U.S.C. §§102 and 103(a)

Claims 1, 2, 5, 11-14, 17, 22, and 29 were rejected under 35 U.S.C. §102(a) and (e) as being anticipated by Ueda *et al.* (U.S. Patent 6,250,812). Claims 1, 5, 11-13, 17, and 29 were rejected under 35 U.S.C. §103(a) as being unpatentable

over Takagi (JP 11-153140). Claims 1, 3, 4, 11-13, and 15-19 were rejected under 35 U.S.C. §103(a) as being unpatentable over Ueda (JP 2000-035043). For the following reasons, Applicants respectfully request reconsideration and withdrawal of the rejections.

1. Differences between claim 1 and US '812 (US 6,250,812 to Ueda)

1.1 US '812

US '812 discloses a rolling bearing which has excellent corrosion resistance and toughness. In the rolling bearing, at least one of the inner race and the outer race is made from a β type titanium alloy or from an α+β type titanium alloy. Further, the surface hardness is no less than Hv 600.

In US '812, as described in the present application, cold working is conducted in a range from 5 to 20% between solution treatment and aging so that it can be shaped as desired and has work strain. This allows the formation of a nuclei of α-phase which is harder than β-phase, and allows the α-phase to be finely deposited within the β phase.

1.2 Differences

The present invention is a further improvement of the US '812 invention. As described in the above Description of Amendments, the surface hardness of the rolling device of the present invention is Hv 400 to 592, and the rolling device has excellent corrosion resistance even when used with very acidic solutions.

As shown in Table 1 of the present application, when compared with Examples 1 to 6 of the present application, Comparative Examples 3-5, which are the rolling bearings of US '812, have surface hardness exceeding Hv 600 and a higher rolling life ratio for salt water. However, corrosion resistance in very acidic solutions is inadequate.

Specifically, the rolling device of the present invention has a smaller weight reduction in the sulfuric acid solution than a bearing of US '812. This is because the surface hardness of the bearing ring made of titanium produced by cold working is Hv 600 or more. Although the bearing of US '812 has excellent fatigue strength, the present invention has stronger corrosion resistance against corrosive fluids such as saline or sulfuric acid (see the specification from the bottom of page 27 to line 5 of page 28).

That is, not only there are differences in surface hardness between the present invention and US '812, but also the present invention has better corrosion resistance than US '812.

2. Differences between claim 1 and JP '140, JP '043, and US '328

2.1 JP '140 (JP 11-1531 40 to Takagi)

JP '140 discloses a rolling bearing for a special environment. The rolling bearing is made from a titanium alloy with an α' martensite structure and has a long service life even under water. In the rolling bearing, at least 1.0 to 5.0 wt% of Cr, 0.2 to 0.9 wt% of oxygen, 0.1 to 0.5 wt% of nitrogen, and 0.1 to 0.5 wt% of

carbon are added to the titanium alloy in order to form the α' martensite structure.

However, there are clear differences in terms of the materials and the surface hardness ranges between JP '140 and the present invention. In JP '140, a replaced type dissolution element or an invaded type dissolution element is added to Ti alloy so that a high surface hardness of more than Hv 633, which could not be obtained in the past with an α+β or β type titanium alloy, is attained.

However, since the surface hardness is improved with an α' martensite structure using strain working, this treatment reduces corrosion resistance just like a conventional alloy steel. Therefore, the rolling bearing of JP '140, the present invention, does not have excellent corrosion resistance against very acid solution.

2.2 JP '043 (JP 2000-035043 to Ueda)

JP '043 discloses a rolling bearing for improving fretting abrasion resistance and for reducing the quantity of lubricant contained in the bearing. In the bearing, a titanium oxide layer is formed on at least one side surface, and a coating thickness of 0.3 to 0.5 μm (300 to 5000 nm) is provided. In other words, the titanium oxide layer is an anatase type, which is super-lipophilic, or a rutile type. Accordingly, by forming the titanium oxide layer on the raceway surfaces

or on the rolling surfaces of the rolling elements, fretting abrasion resistance can be improved, and the quantity of lubricating oil can be reduced.

However, unlike the present invention, JP '043 has no disclosure regarding surface hardness.

2.3 US '328 (US 2001/0036328 to Yamamoto)

US '328 discloses a rolling bearing which is suitable for use in the vicinity of a heat source. The outer ring, which is closer to the heat source than the inner ring, is composed of a material with a heat conductivity of 40 W/m·K or less.

However, US '328 discloses nothing regarding the material for the raceway ring and regarding surface hardness.

3. Others

3.1 Anticipation

Claim 1 is not anticipated by US '812, because the surface hardness of US '812 is over Hv 600 and is not within the range of the present invention. Further, the other references also do not teach or suggest the surface hardness claimed by the present invention. Therefore, the present invention cannot be anticipated by any of the cited references.

3.2 Obviousness

Claims 3 and 4 of the present application, as amended, each recite that the thickness of the oxygen compound layer is 95 nm or less. In JP '043, on the other hand, the thickness of the titanium oxide layer is 0.3 to 0.5 μm (300 to 5000 nm), which is outside of the claimed range.

Further, with the thickness specified in claims 3 and 4, the core hardness of the bearing ring can be increased to Hv 420 or more (see the specification from page 43 to line 8 of page 44).

Claim 5 was rejected as anticipated by US '812 and as obvious in view of JP '140, but neither US '812 nor JP '140 teaches surface hardness or corrosion resistance according to the present invention.

Claims 11 to 13 were rejected as anticipated by US '812 and as obvious in view of JP '140, but neither reference teaches claim 1 of the present application.

Claims 15 to 16 were rejected as obvious in view of JP '043, and claim 17 was rejected based on each of US '812, JP '043, and JP '140, but each reference does not teach claim 1 of the present application.

In summary, none of the cited references teaches or suggests that the surface hardness is Hv 600 or less for corrosion resistance against very acidic solutions. When the surface hardness is out of the range of the present invention, high corrosion resistance cannot be necessarily obtained.

In light of the foregoing remarks, this application is considered to be in condition for allowance, and early passage of this case to issue is respectfully requested. If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (CAM #: 038921.50926US).

Respectfully submitted,

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